Climate Change & Health

EPA State and Local
Annapolis, MD Nov. 2002

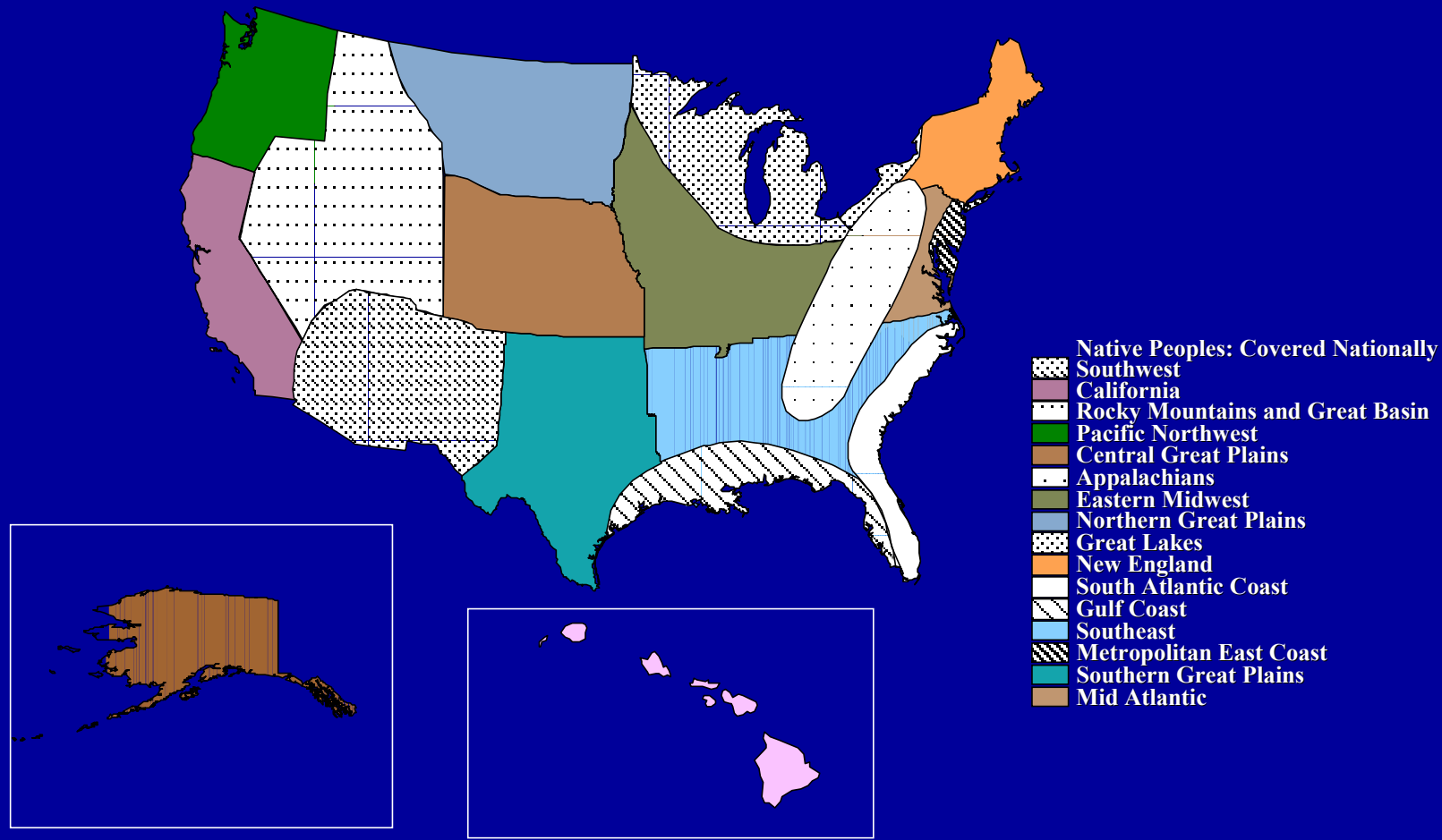
Jonathan Patz, MD, MPH, Director

IPCC Third Assessment Report Conclusions (cont.)

- **"There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities"**
- **Human influences will continue to change atmospheric composition throughout the 21st century**
- **Global average temperature and sea level are projected to rise under all IPCC SRES scenarios**
  - Global surface temps. increase **1.4–5.8°C** by 2100
  - Global mean sea level rises by **9–88 cm** by 2100

Slide: Courtesy of Anne Grambsch, US EPA

U.S. Global Change Research Program: National Climate Change Assessment Regions



Source: USGCRP

Five National Climate Research Sectors

HEALTH EFFECTS OF CLIMATE CHANGE

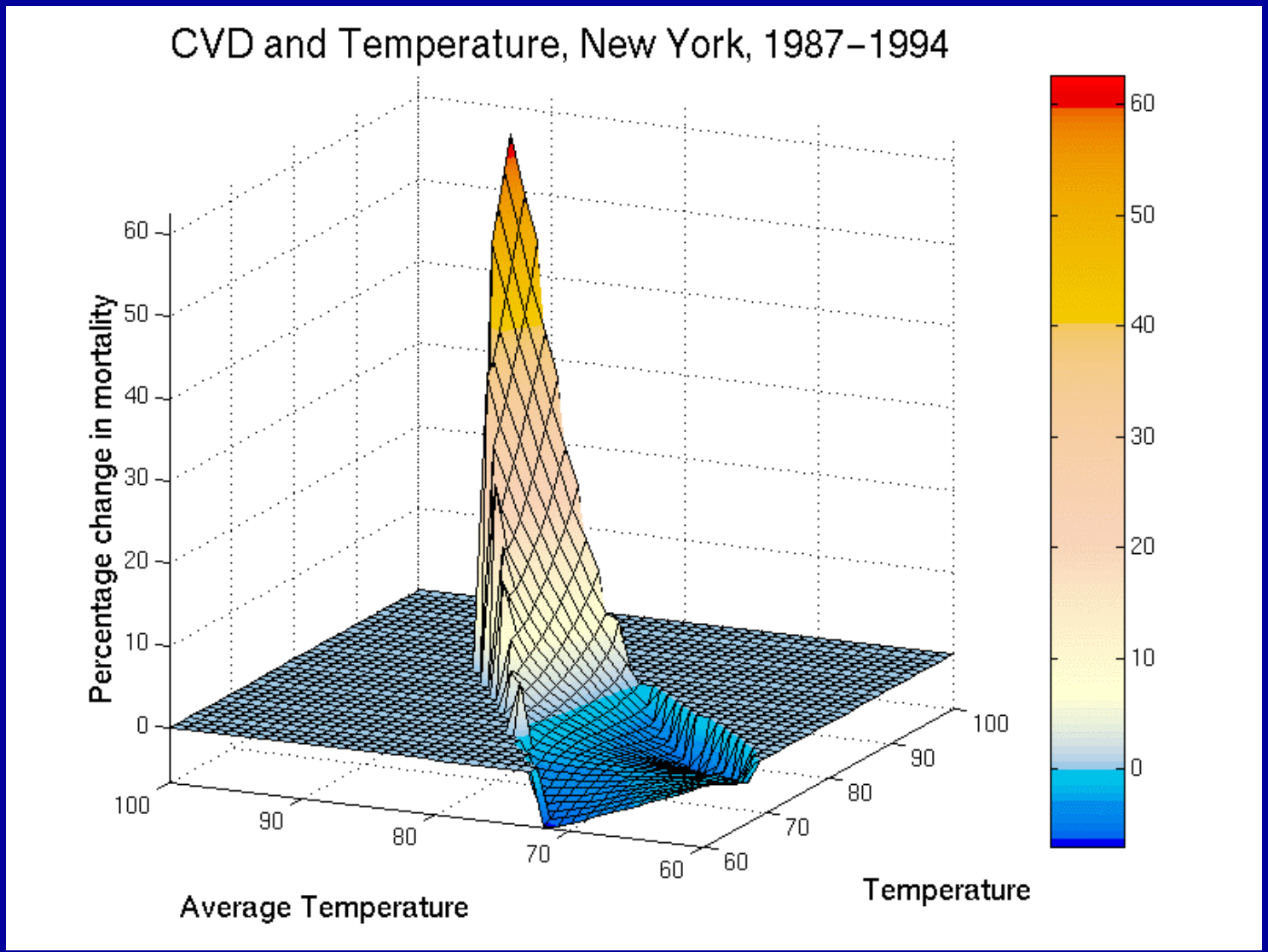
CLIMATE CHANGE

Temperature Rise [1]
Sea level Rise [2]
Hydrologic Extremes

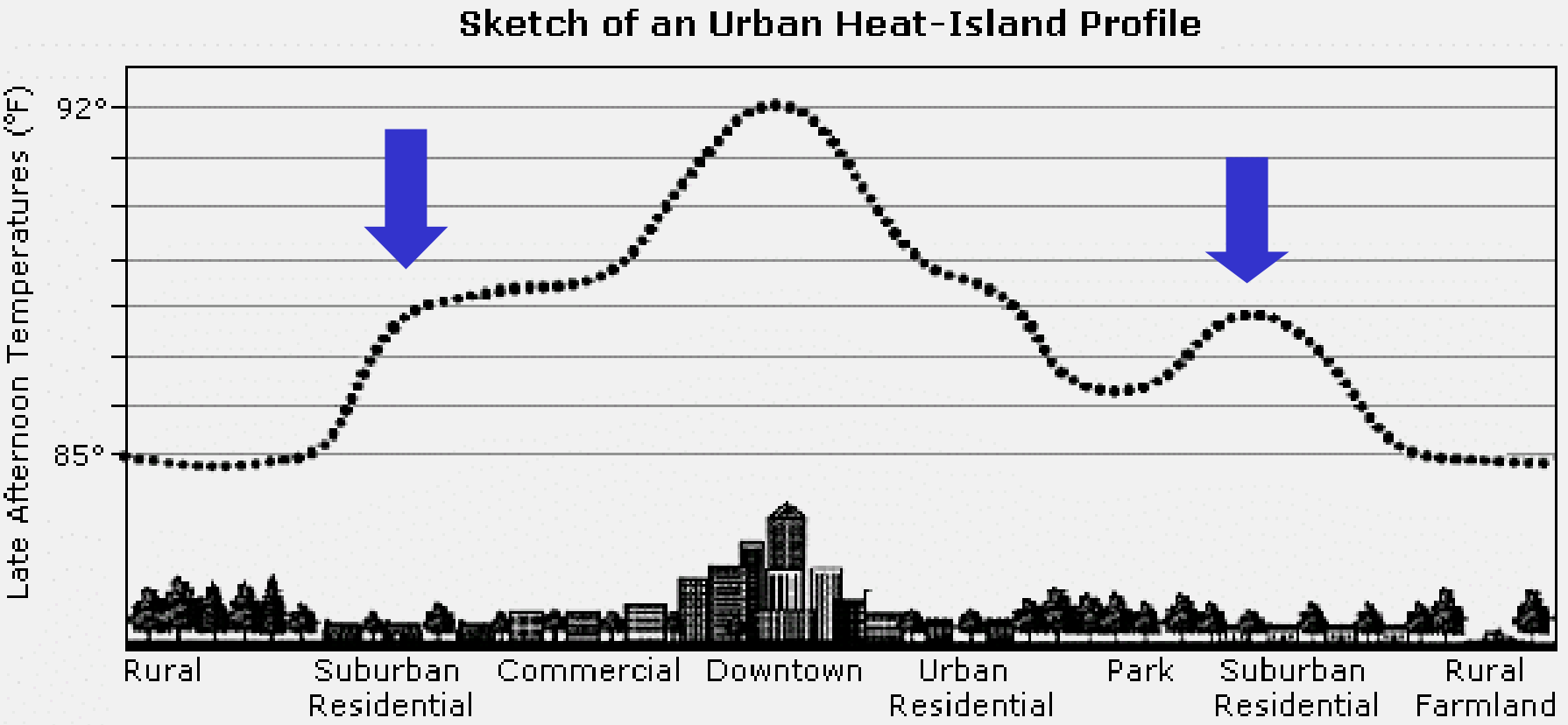
[1] **3°C** by yr. 2100
[2] **40 cm** " "
IPCC estimates

Urban Heat Island Effect	Heat Stress Cardiorespiratory failure
Air Pollution	Respiratory diseases, e.g., COPD & Asthma
Vector-borne Diseases	Malaria Dengue Encephalitis Hantavirus Rift Valley Fever
Water-borne Diseases	Cholera Cyclospora Cryptosporidiosis Campylobacter Leptospirosis
Water resources & food supply	Malnutrition Diarrhea Toxic Red Tides
Environmental Refugees	Forced Migration Overcrowding Infectious diseases Human Conflicts

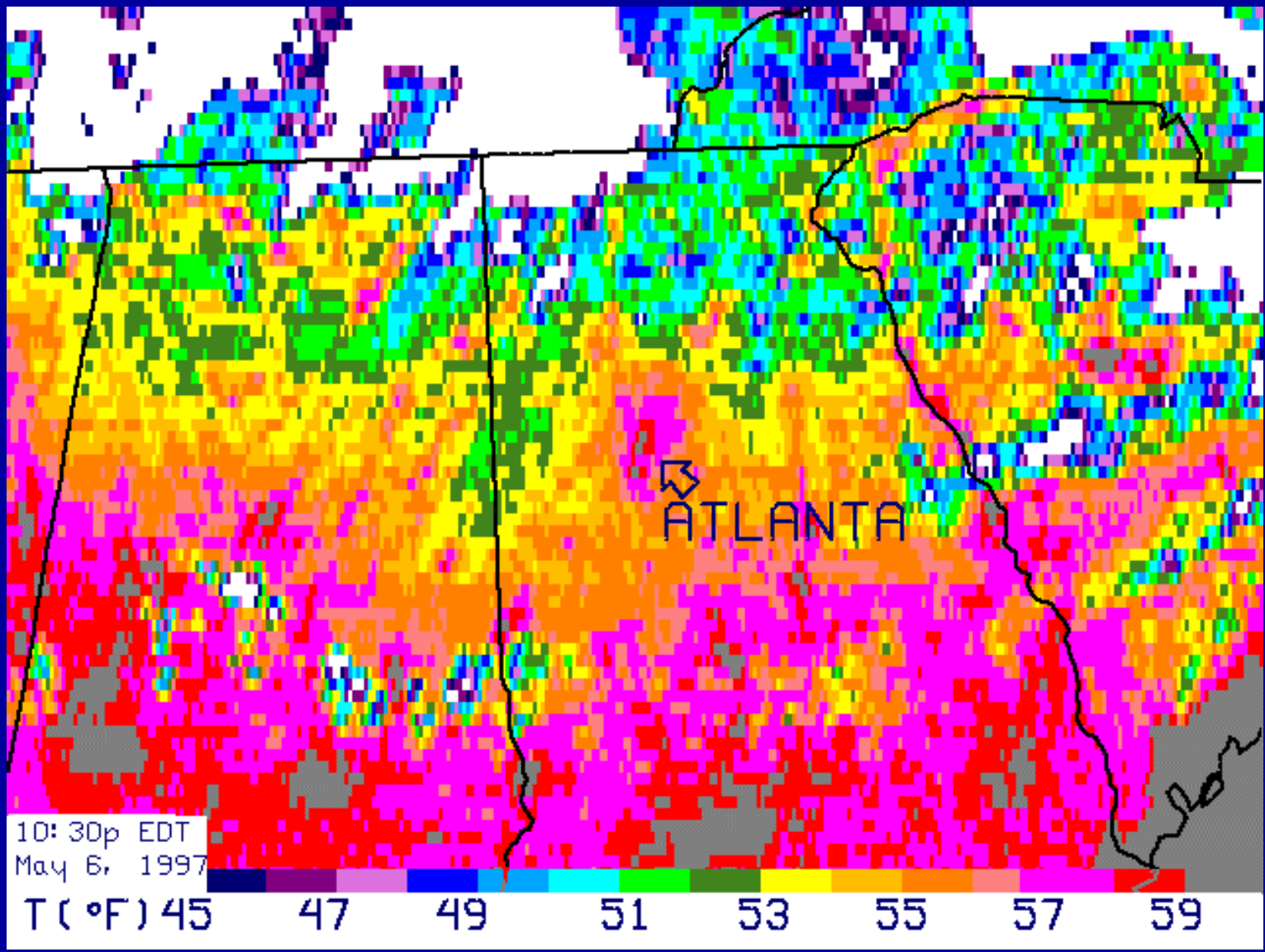
Johns Hopkins University


CVD and Temperature, New York, 1987–1994
Percentage change in mortality
60
50
40
30
20
10
0
100
90
80
70
60
Average Temperature
100
90
80
70
60
Temperature
60
50
40
30
20
10
0

The Heat Island



Atlanta's Heat Island



Source: NASA Marshall Space Flight Center

Relationship between temperature and ground-level ozone

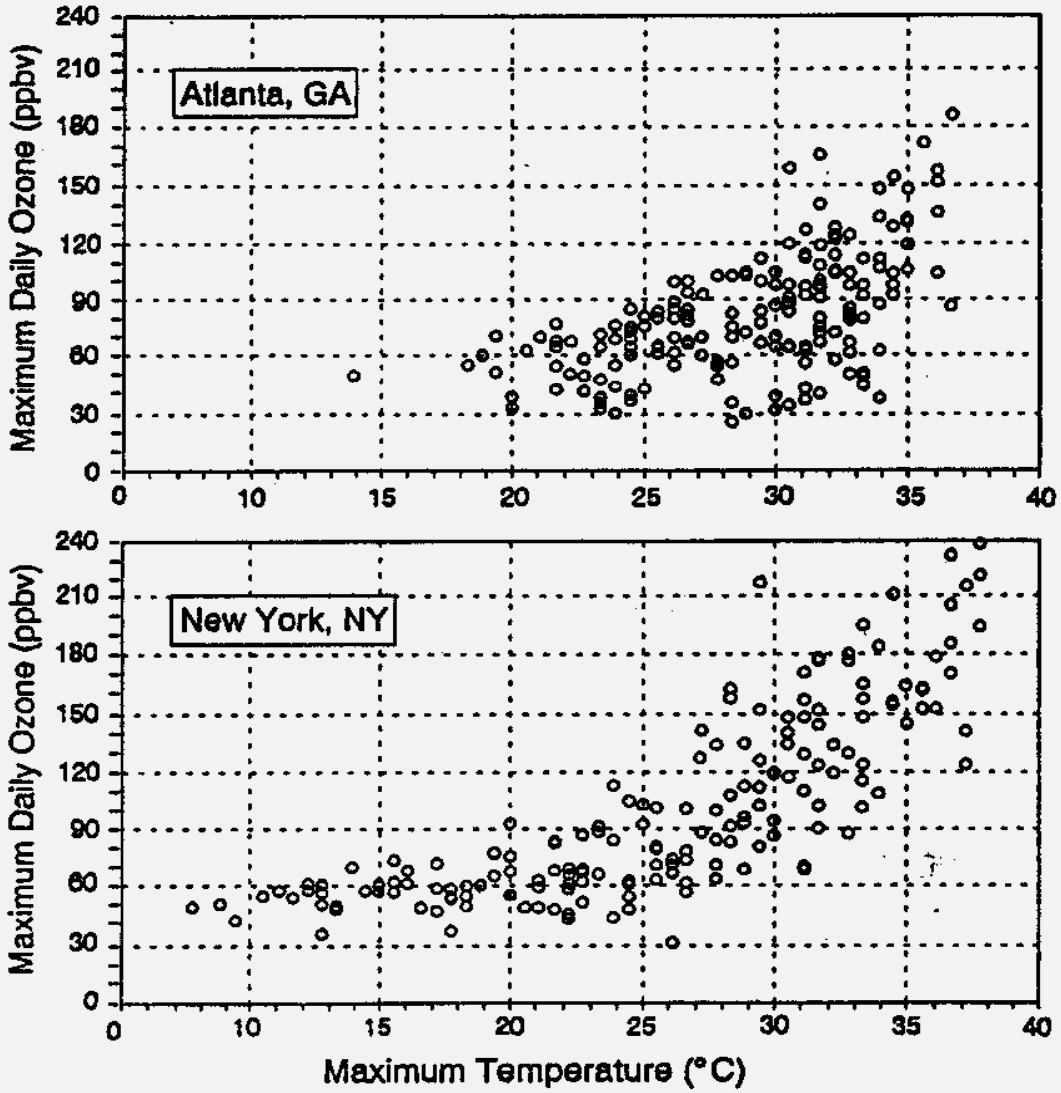
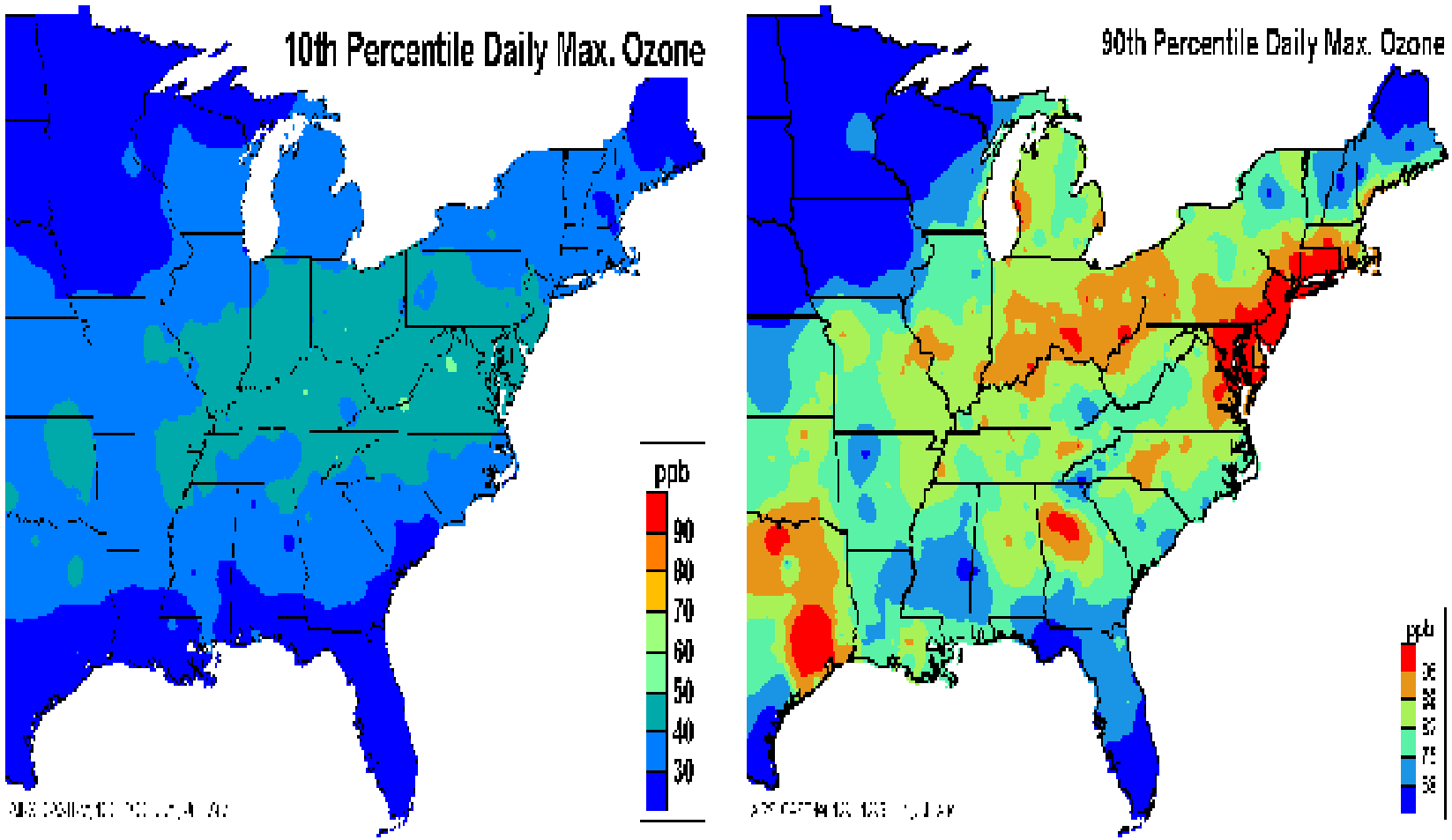


Figure 5-3. Maximum daily ozone concentrations in Atlanta, GA, and New York, NY, versus maximum daily temperature, May-October, 1988-1990

Source: (USEPA 1996a)

Spatial variation in ozone: background and peak

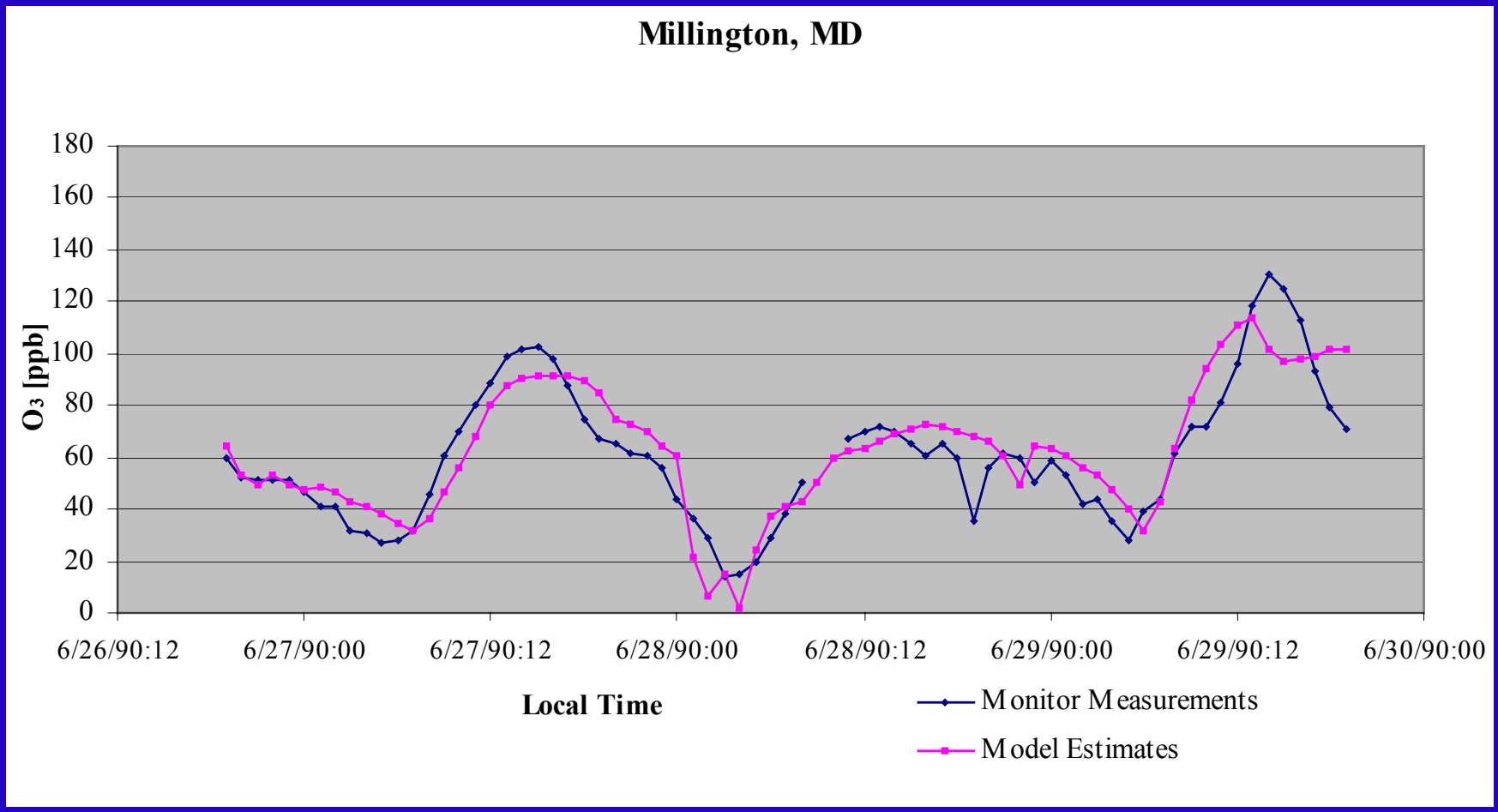


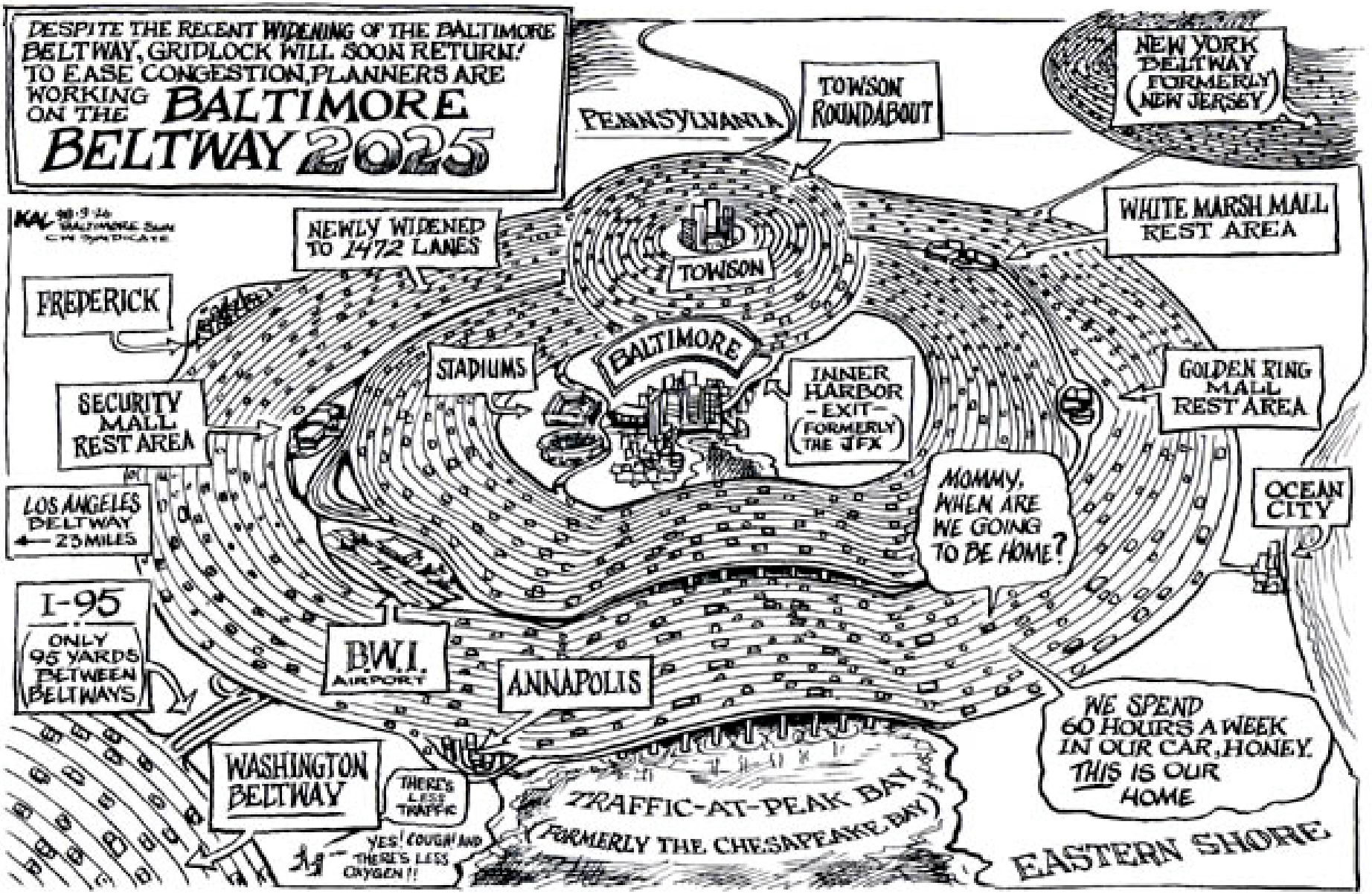
from OTAG final report, see http://www.epa.gov/ttn/rto/otag/finalrpt/

EPA United States Environmental Protection Agency

Applying MODELS-3 (EPA Air Pollution Model) to Mid-Atlantic Region

H. Ellis, M. Bell, J. Patz





September 26, 1998

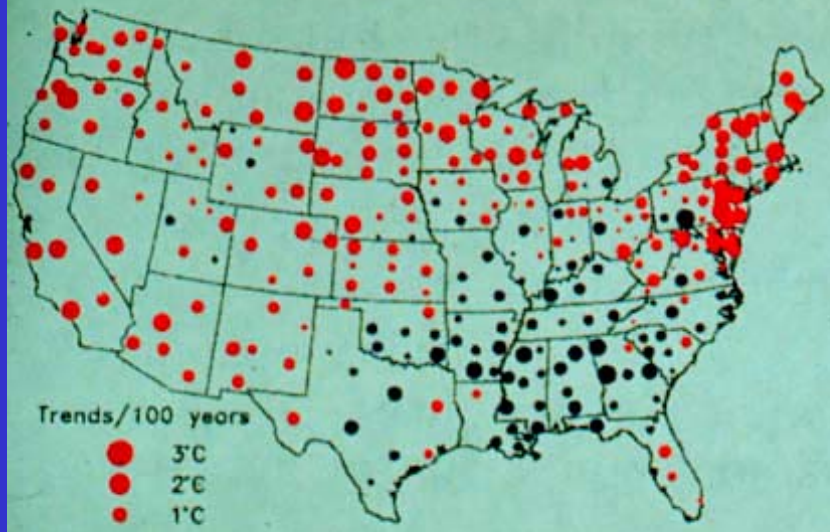
The Beltway was widened, but commuters hardly noticed.

Climate change:

It's not just about warming.

Temperature and Precipitation Trends, 1900 to Present

Temperature

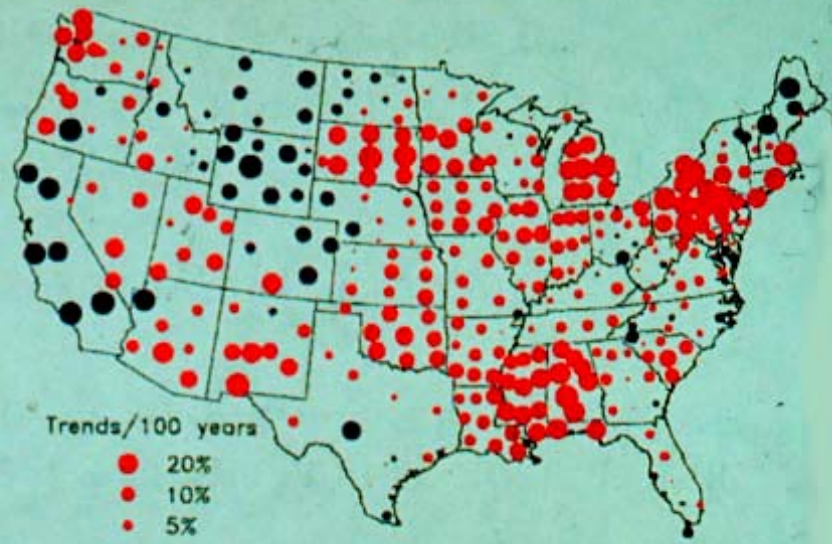


Red circles reflect warming; blue reflect cooling

Note: Unexpected cooling in southeast U.S. due to sulfate aerosol influence

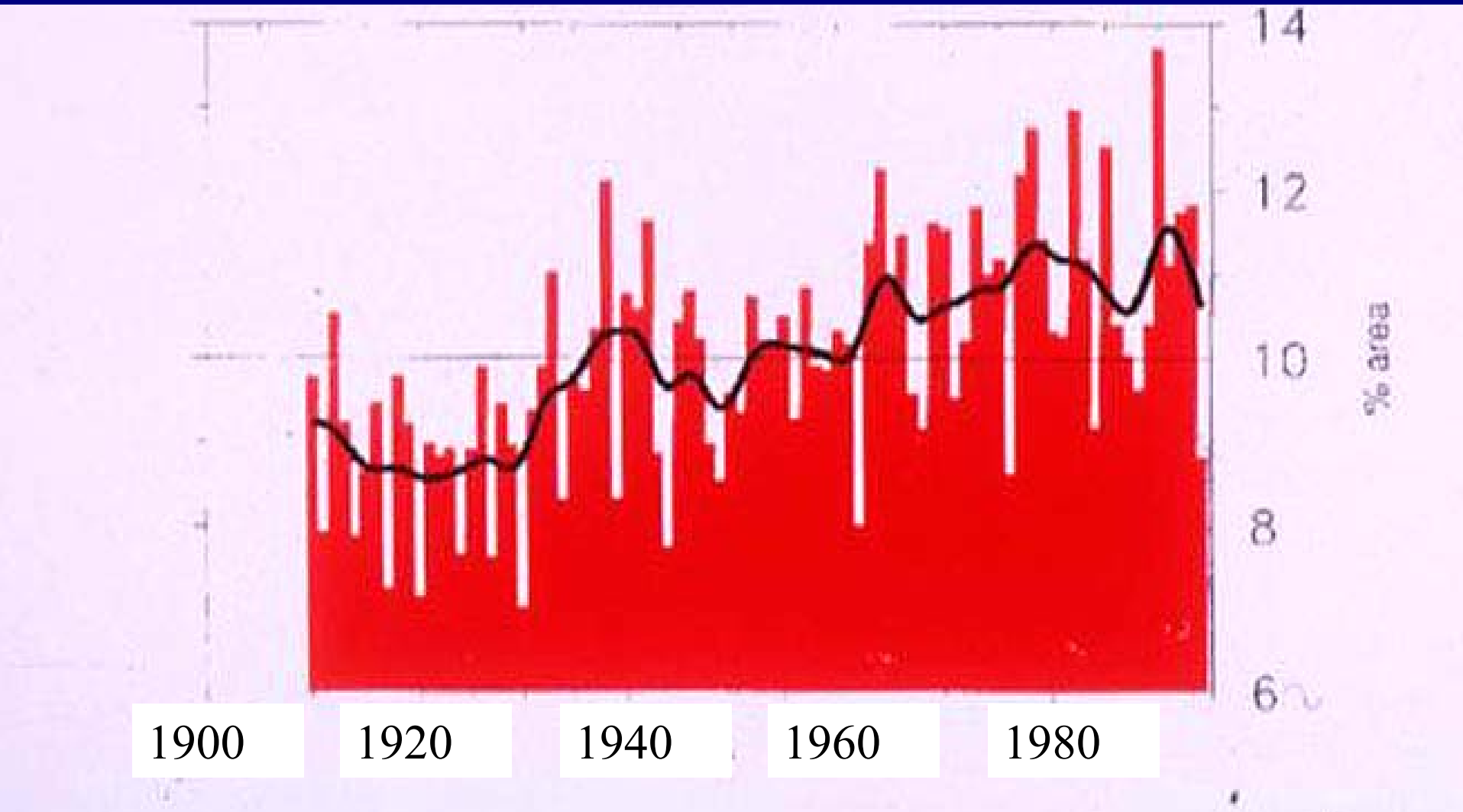
Source: Karl et al. (1996)

Precipitation

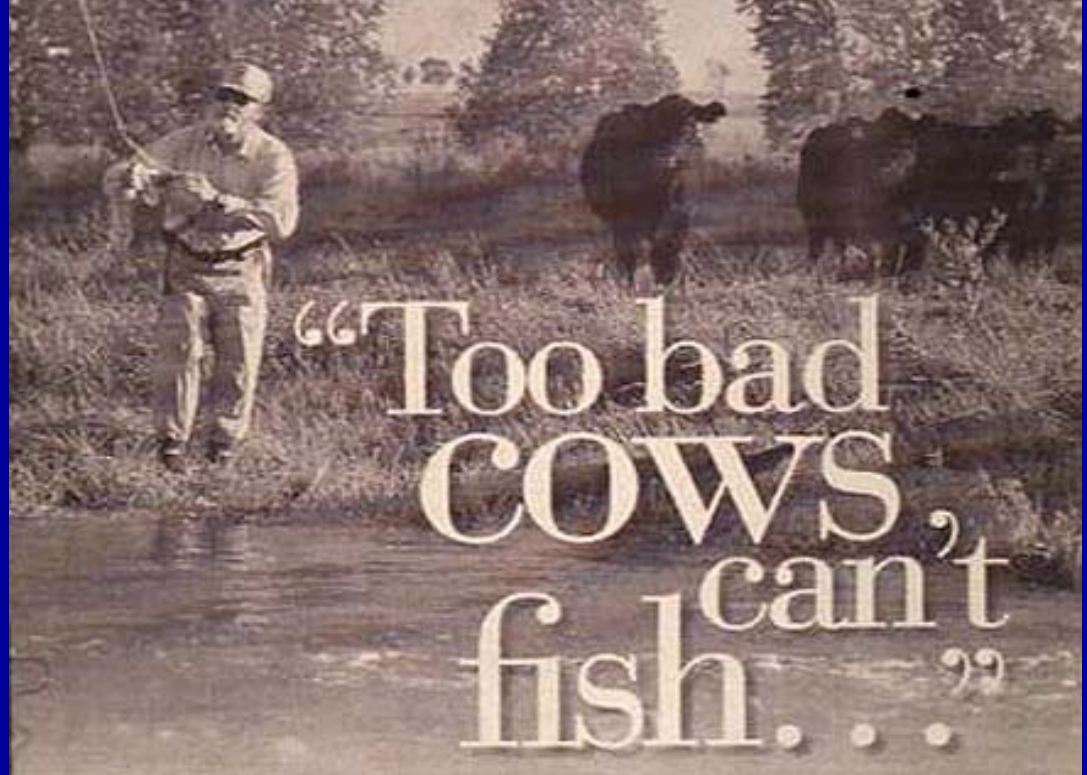


Red circles reflect increasing precipitation; blue reflect decreasing precipitation

Proportion of the USA affected by much above normal annual precipitation from extreme events (>2 inches/day)



Source: Karl et al. 1996



"Too bad COWS can't fish..."

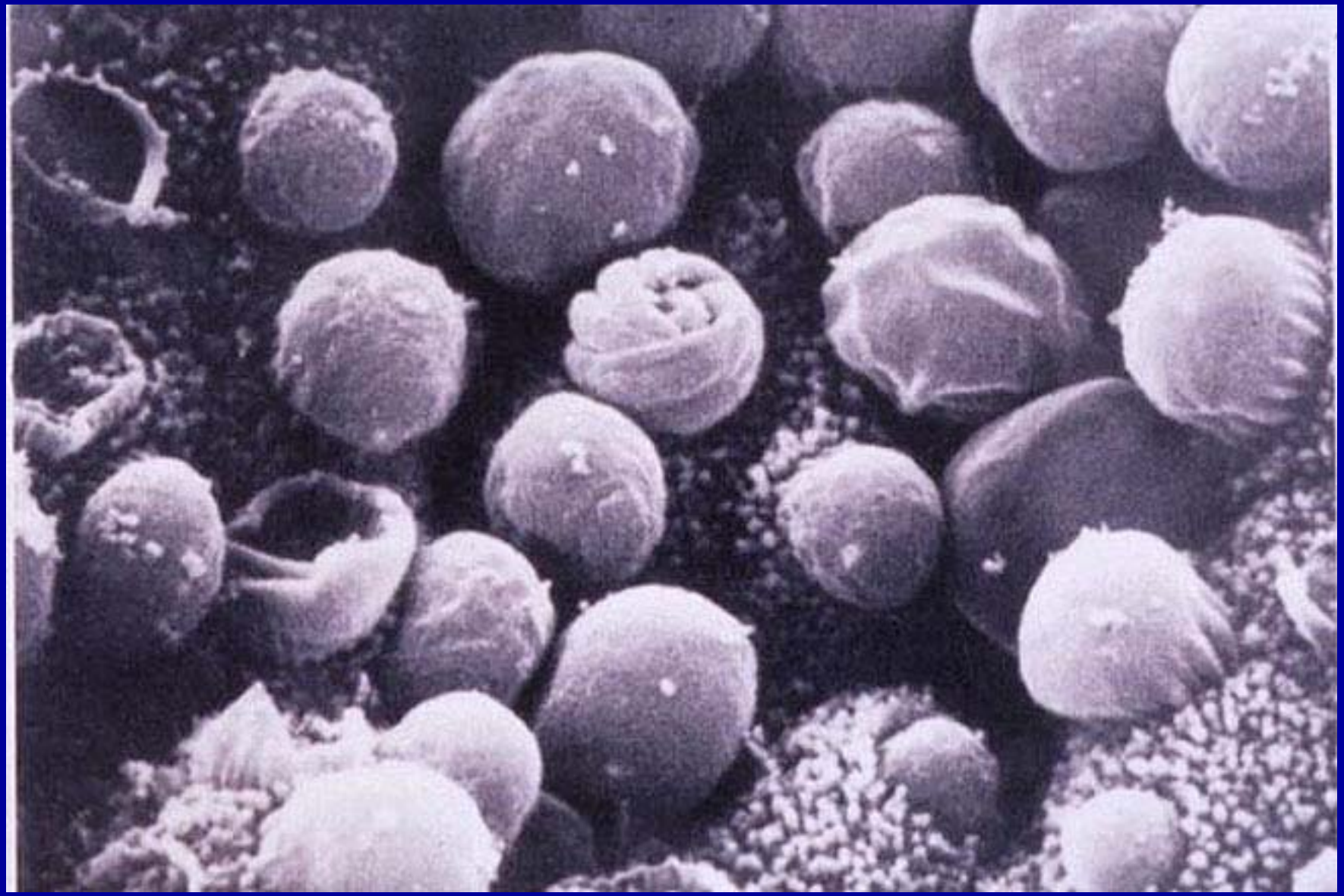
"Because they live by some great streams."

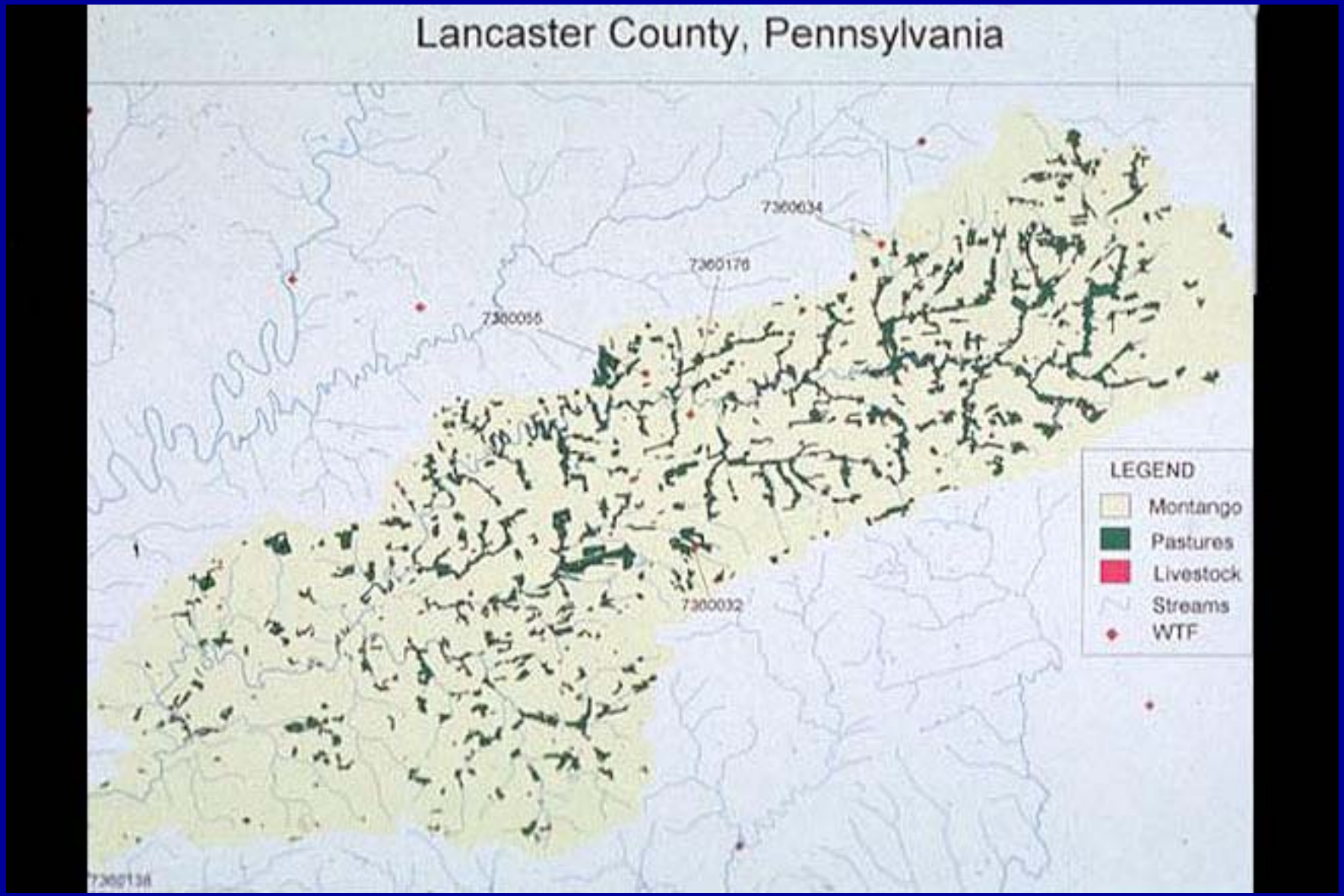
"That's Ernie Reeves' farm in the picture. Nice fishing. In fact, Ernie just won an award for conservation in Virginia. My name's Robert E. Lee, and I just won here in Montana. We're winners because we've worked hard to make the land better for all creatures. Like using cattle to protect the creeks – bringing them in to control vegetation, then rotating them to other land. We've even built a reservoir to support cattle and a new fishery at the same time. You see, everything's pretty much related: what's good for the environment is good for cattle. And healthier cows means better food for your table."

- Robert E. Lee & family, Judith Gap, MT (National Winners, 1997 Environmental Stewardship Award)

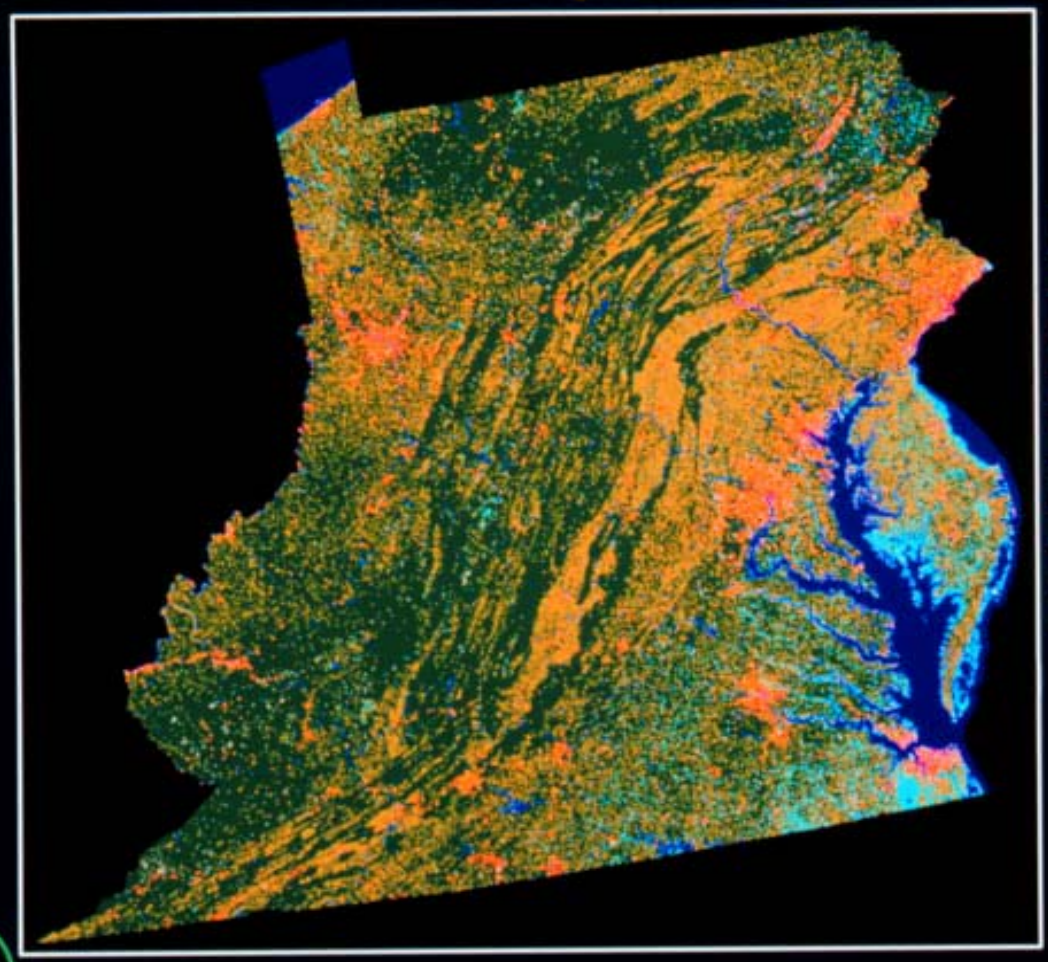
"When I want to see nature thriving, healthy...I look right here, on my ranch."

Cattlemen. Stewards of an American Tradition




Lancaster County, Pennsylvania
7360034
7360176
7360056
7360032
LEGEND
Montango
Pastures
Livestock
Streams
WTF

MRLC Region 3
(Mid-Atlantic)

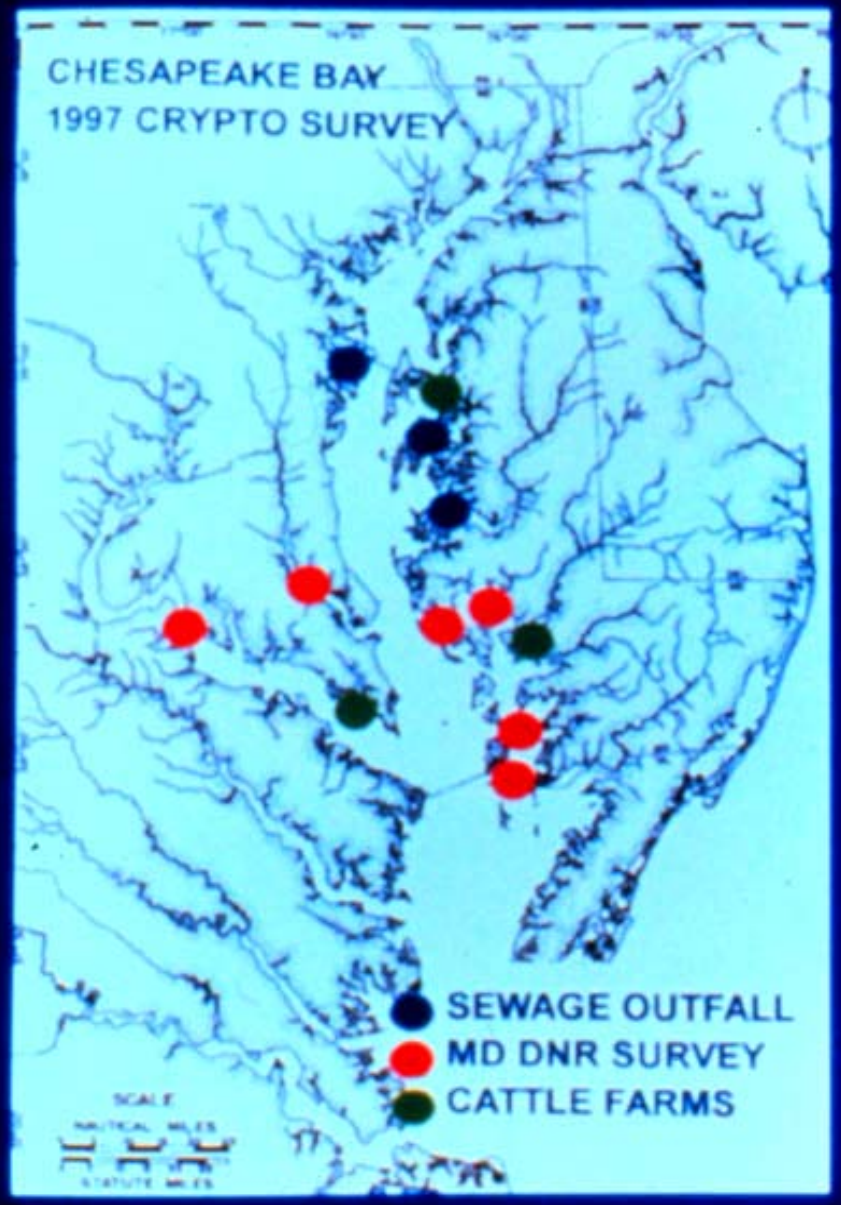


- No Data
- Water
- Low Intensity Development
- High Intensity Development
- High Intensity Commercial
- Bare Rock / Quarry / Barren
- Forest
- Agricultural
- Other grass
- Wetlands

Life Sciences Division

Ames Research Center

NASA



SEWAGE DISCHARGE SITES

Cambridge outfall-Choptank R.
Annapolis outfall-Severn River
Annapolis South outfall
St. Michaels outfall-Miles River

CATTLE RUNOFF SITES

Pintail point- Wye River
Mt. Vernon Wharf-Wicomico R.
H.Lundenberg farm- Potomac

DNR SITES

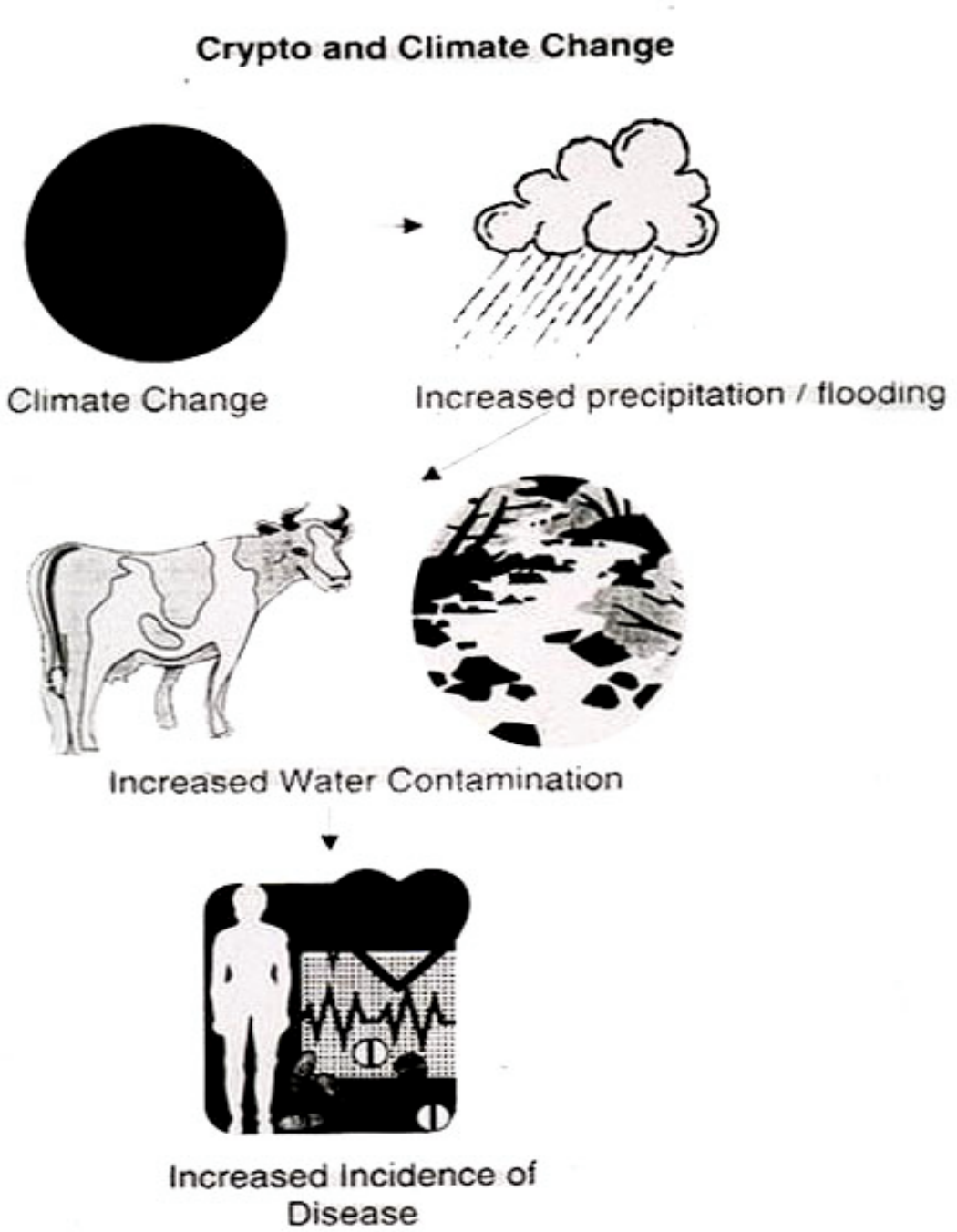
Wetipquin-Naticoke River
Halfway Mark-Fishing Bay

Integrated assessment of cryptosporidiosis risk under future climate change scenarios.

Study site (Lancaster county), 64% of livestock operations tested positive for crypto oocysts in manure.

(Graczyk et al 2000)

For all waterborne disease outbreaks in US, 1948-94, significant assoc. with preceding heavy rainfall events (Curriero, Patz et al 2001)



Milwaukee 1993

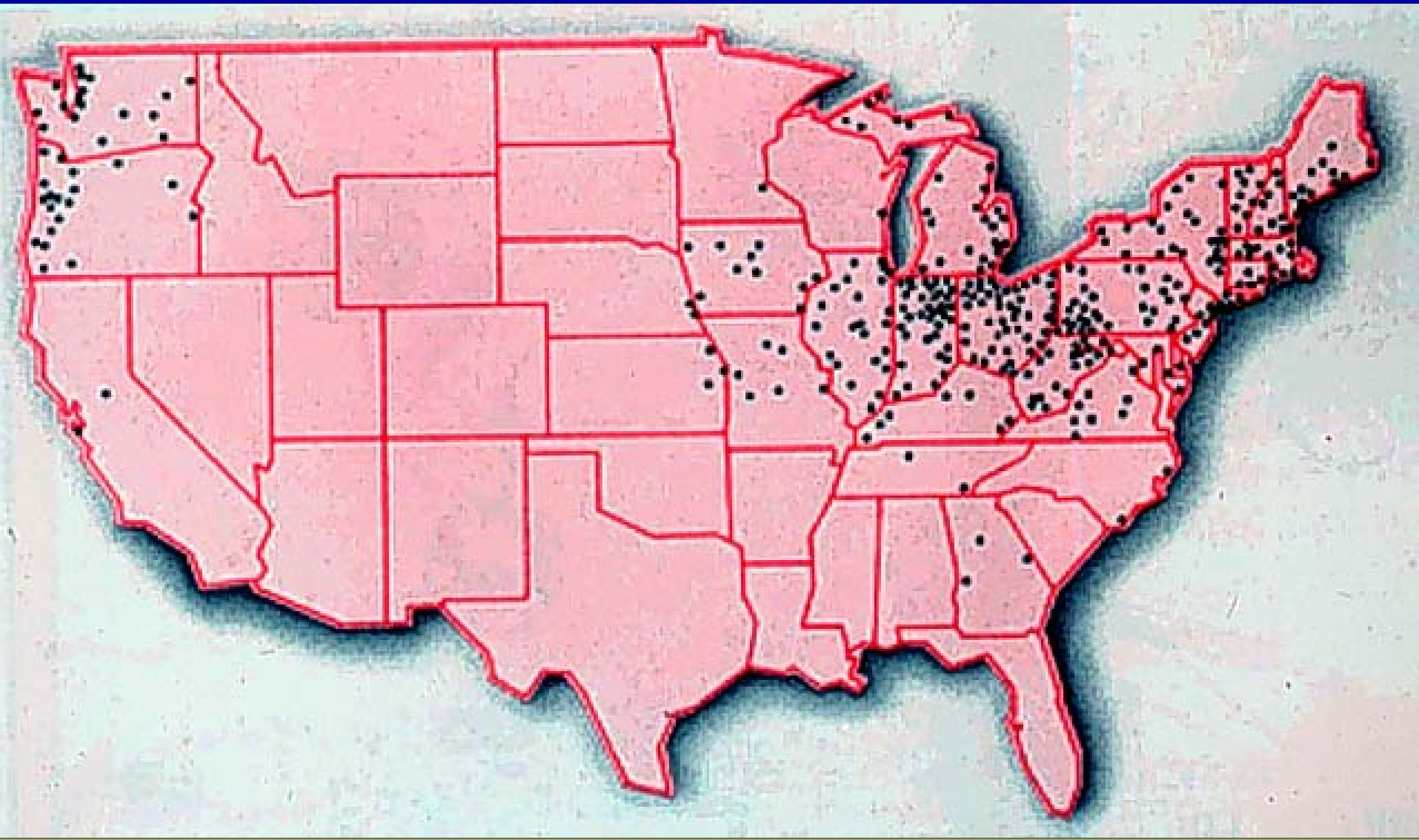
Cryptosporidiosis epidemic

405,000 cases

54 fatalities

Preceded by heaviest rainfall in 50 years

Location of Combined Wastewater Systems



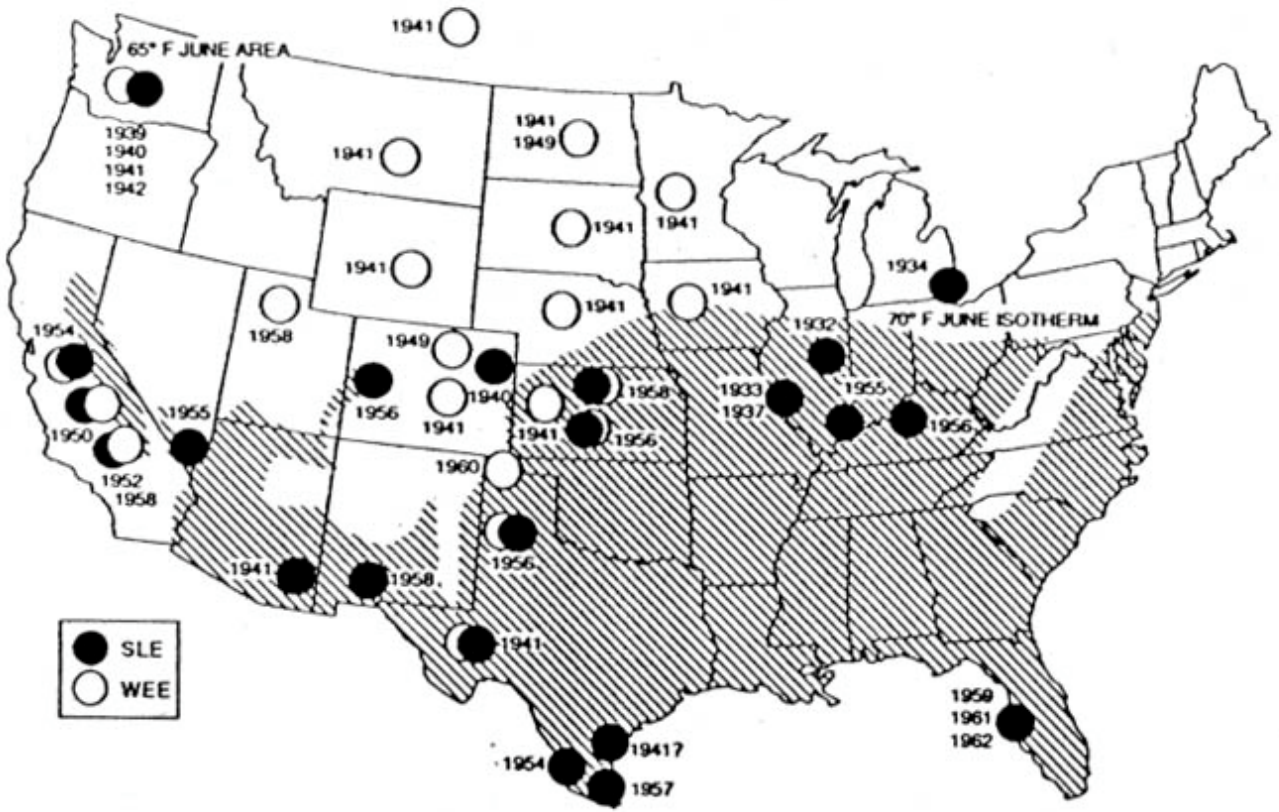
Source: US EPA

USA: Combined sewer overflows (CSOs)

1.2 trillion gal of sewage & stormwater a year discharged during combined sewer overflows – would keep Niagara Falls roaring for 18 days

JOHNS HOPKINS UNIVERSITY
CWH
Center for Water and Health


HEALTH PROFESSIONALS AND SCIENTISTS WARN OF SPREADING INFECTIOUS DISEASES.
Global Warming's greatest threat may also be the smallest.



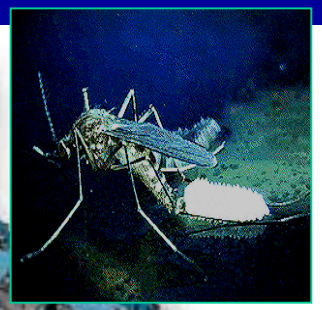
Distribution of recorded human outbreaks of St. Louis and Western Equine encephalitis in the US in relation to 21°C June isotherm. (From Hess et al., 1963).

Stormwater

- Storm drains in urban settings known to account for 50-90% of the vector mosquitoes in local areas
- People living within 160m of manhole or well are 2.47 times more likely to have Dengue exposure
- Subterranean habitat largely overlooked

Courtesy: Doug Norris

Survival of WNV through the winter and resurgence in 2000 ?



Local survival
re-emergence

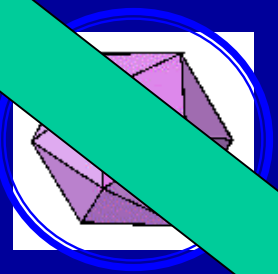
Re-introduction

shown on a map of the
ecological regions of North America

Courtesy: B. McLean

West Nile Virus Transmission Cycle

- Trans-seasonal maintenance
  - Overwintering

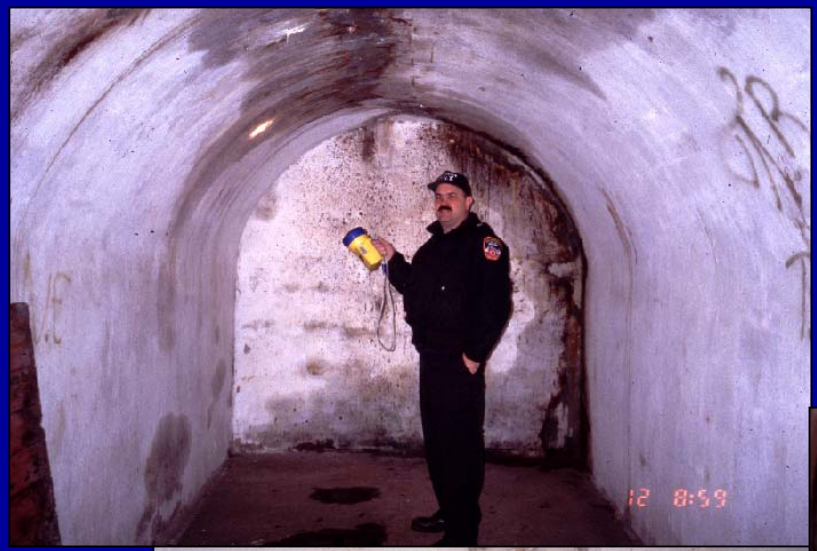


- Vertical transmission
  - Transovarial
  - During oviposition
- Hibernation of blood-fed female

Courtesy: B. McLean

CDC

Locations for hibernating mosquitoes in NYC



Courtesy: B. McLean

CDC

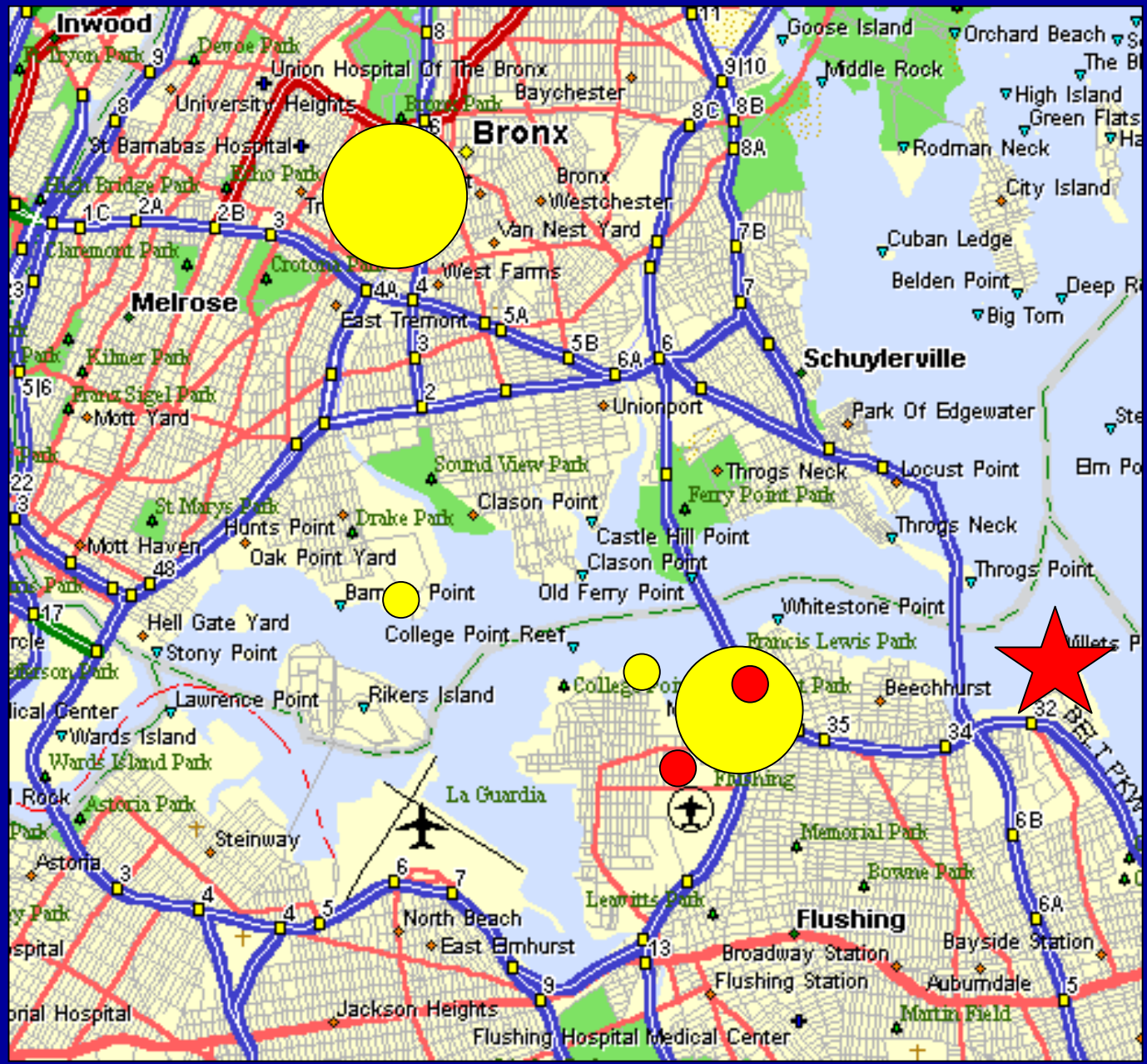
Overwintering mosquito collections:

Jan-Feb, 2000

Sewer related structures

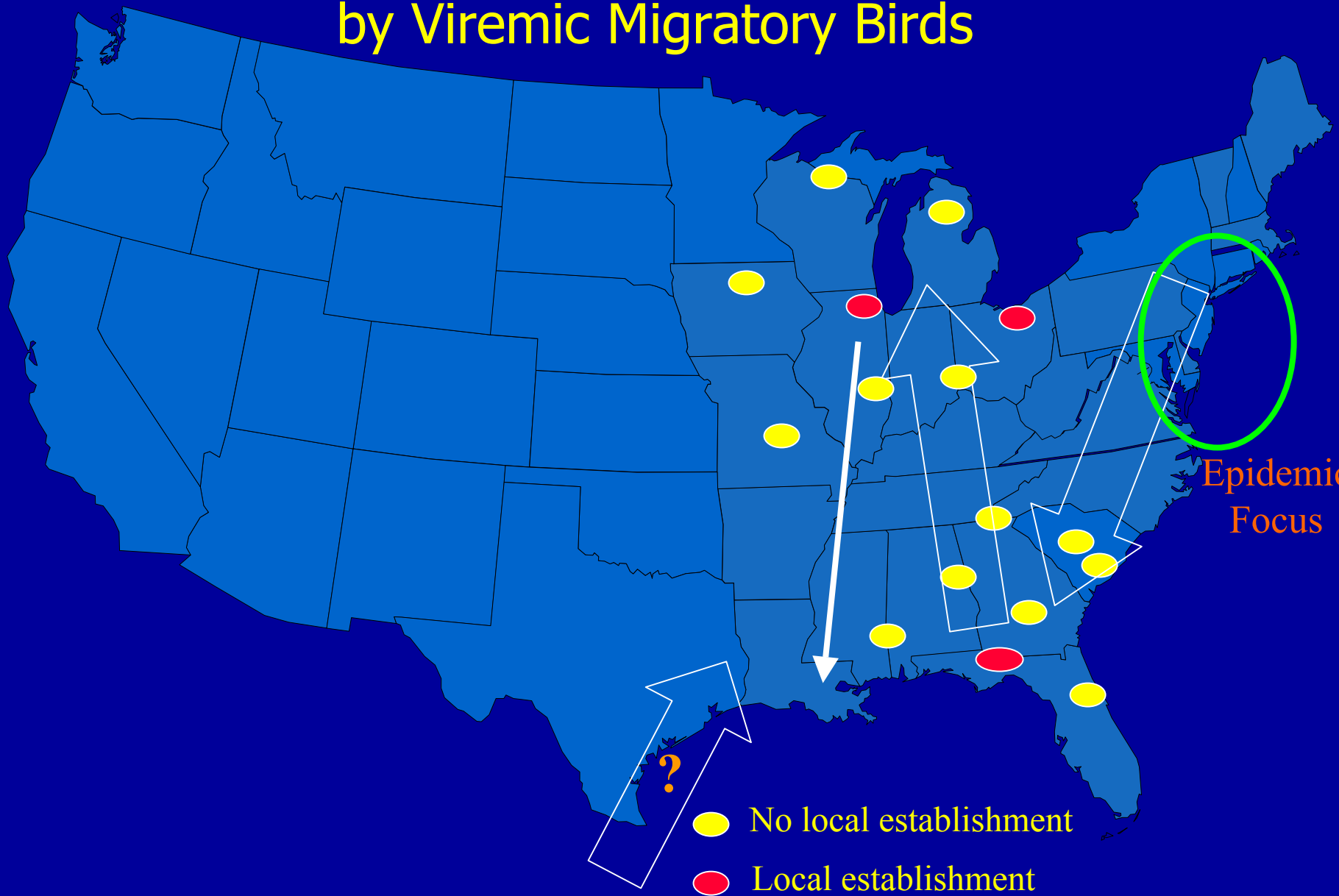
Other Structures

Virus found at Ft. Totten



Courtesy: B. McLean

Movement and Seeding of West Nile Virus by Viremic Migratory Birds



Courtesy: B. McLean

Key Websites for further information

1) www.jhsph.edu/globalchange

2) " " " /nationalassessment-health

3) www.ipcc.ch